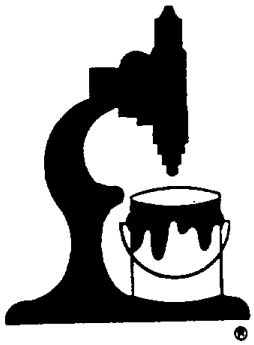
TESTING OF ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS

FINAL REPORT
Contract No. 92-339

Prepared for:

Research Division
California Air Resources Board
2020 L Street
Sacramento, CA 95814

Submitted by:



Harlan Associates, Inc.
Paint Research Laboratory
11 Duboce Avenue
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Prepared by:

Harold R. Harlan, Jr.
Principal Investigator

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This report was submitted in fulfillment of ARB Contract No. 92-339 Testing of Architectural and Industrial Maintenance Coatings by Harlan Associates, Inc., Paint Research Laboratory under the sponsorship of the California Air Resources Board. Work was completed as of February 1995.

DISCLAIMER

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

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ABSTRACT

This study covers testing and analyses of commercially available architectural and industrial maintenance coatings, both solvent and water-borne. The project included determination of the Volatile Organic Compound (VOC) contents along with physical testing of the performance properties of the samples.

A general testing schedule was presented by the California Air Resources Board (CARB), and amended to meet each category to be tested. A total of 110 products were tested, under eight categories.

Samples for evaluation were obtained by the Contractor from a list supplied by CARB, delivered to CARB for "blind" coding (to mask the manufacturer identity of the coating), then returned to the Contractor for splitting/transferring to smaller containers. Specimens of each sample were supplied to the subcontractors for partial testing as directed by the contract.

VOC and performance tests on the samples were conducted by the Contractor and subcontractors, utilizing test methods cited or developed by the American Society for Testing and Materials (ASTM), Federal Test Method Standard (FTMS), Federal Specifications and the Contractor. Data were compiled for each product evaluated and is presented in this report. No comparison of the properties or performance of the samples was required by this contract.

SUMMARY

The purpose of this study was to determine VOC content and physical properties of 115 products in eight coating categories. No comparison of data is provided under this contract. This record will aid decisions by CARB on new regulatory needs.

The total number of products to be tested was decreased by four to allow for the Contractor to perform splitting/transferring of products to smaller containers, work which was not included in the Contractor's proposal. This number was finally decreased to a total of 110 products due to the inability to obtain a product listed on the Industrial Maintenance Primers procurement list.

While the Contractor was capable of performing all testing required by the contract, the Contractor utilized subcontractors to meet goals established by the State of California in regard to Minority Business Enterprise, Women Business Enterprise, and Disabled Veteran Business Enterprise participation.

At the request of CARB, the Multi-color coating category was replaced by Varnishes.

After discussion and review of the Primer, Sealer, Undercoater procurement list provided by CARB it was clear that most of the products referenced themselves as primer/sealers, not undercoaters. For this reason the category was renamed "Primer/Sealers".

A summary of individual coating category descriptions, number, and type of products tested in each category are as follows:

Industrial Maintenance Coatings are high performance coatings formulated for and applied to substrates in industrial, commercial, or institutional situations that are exposed to extreme environmental conditions. This category was divided into sub-categories of primer and topcoats. Primers included thirteen products of which ten were single component (6 water-borne, 4 solvent-borne) and three were two-component (2 water-borne, 1 solvent-borne). Topcoats included twelve products of which eight were single component (4 water-borne, 4 solvent-borne) and four were two-component (1 water-borne, 3 solvent-borne).

High Temperature Industrial Maintenance Coatings are coatings formulated for and applied to substrates exposed continuously or intermittently to temperatures above 400 degrees Fahrenheit. A total of five materials were tested, and included 2 two-component coatings.

Lacquers are clear wood finishes formulated with nitrocellulose or synthetic resins to dry by evaporation without chemical reaction, and include clear lacquer sanding sealers. This category covered testing of fifteen products (8 water-borne, 7 solvent-borne), of which three were clear lacquer sanding sealers. Analytical results suggest that two of the lacquer samples dried by chemical reaction.

Varnishes are a type of clear coatings which are converted to transparent solid film after application, primarily by chemical reaction. A total of five products (2 water-borne, 3 solvent-borne) were tested under this category.

Non-Flats are coatings which register a gloss of five or greater on a 60 degree meter, and are identified as gloss, semi-gloss or enamels. CARB requested that we obtain standard off-white, semi-gloss products, whenever possible. This category was divided into sub-categories of exterior and interior materials. Non-Flat Exterior coatings included a total of ten products (5 water-borne, 5 solvent-borne). Non-Flat Interior coatings also had a total of ten products for testing (8 water-borne, 2 solvent-borne). Quick-dry enamels were included in this category.

Primer/Sealers - Primers are identified as coatings formulated for and applied to substrates to provide a firm bond between the substrate and subsequent coats. Sealers are coatings formulated for and applied to a substrate to prevent subsequent coatings from being absorbed by the substrate, or to prevent harm to subsequent coatings by materials in the substrate. Primers and sealers were combined to a single category and included quick dry primer/sealers. A total of twenty products were tested under this category of which twelve were water-borne and eight were solvent-borne. In addition, five products were specifically for use on wood and two products were designated not for use on wood.

Sanding Sealers are defined as clear wood coatings formulated for and applied to bare wood for sanding and to seal the wood for subsequent application of varnish. This category covered testing of five products (3 water-borne, 2 solvent-borne).

Waterproofing Sealers are identified as colorless coatings which are formulated and applied for the sole purpose of protecting porous substrates by preventing the penetration of water and which do not alter surface appearance or texture. This category included a total of fifteen products, of which seven were for use on wood (5 water-borne, 2 solvent-borne) and eight for use on concrete (7 water-borne, 1 solvent-borne). The water-borne materials for use on concrete included a two-component product and a concentrated material for dilution.

Many of the products were known to be non-compliant at the time of procurement and were submitted by the manufacturers for testing under this contract only. These non-compliant products were not readily available for sale in the Bay Area Air Quality Management District.

Report sheets are provided in Appendices A - J for each product tested. Test data were compiled from work completed by the Contractor and subcontractor utilizing test methods cited or developed by the American Society for Testing and Materials (ASTM), Federal Test Method Standard (FTMS) 141, Federal Specifications, and/or the Contractor. To maintain consistency and precision of data reported, the Contractor duplicated a minimum of 20% of the tests on samples submitted for testing by each subcontractor. Analyses were confirmed to be within ASTM precision test limits.

Overall comparison of coatings test performance was not required in this contract.

INTRODUCTION

The California Air Resources Board (CARB) is charged with examining all California based sources of potential contaminants in air, those that may be directly harmful to the environment, or those that may be precursors to harmful contaminants that develop with exposure to sun, ultra-violet light or moisture in the air. The incidence of "smog", a fog laced with other chemicals hypothesized as resulting originally from smoke, became a fairly common occurrence in the Los Angeles and San Francisco basins in the late '50's and early '60's. The organic constituents were found to have peroxyacyl nitrates, and the precursors were felt to be the organics from commerce and industry, such as solvents and fuels. Paint industry solvents were regulated, initially with the "Rule 66", and efforts to reduce or eliminate these potential sources of organics in the air have been encouraged.

The physical characterization of paint industry products was started with projects conducted for CARB by DL Laboratories (a New York City laboratory) in 1981[1] and 1984[2]. A subsequent study was done by CalCoast Analytical Labs of Berkeley in 1986-1987[3], with the sample paints collected, divided and blind labelled under a separate contract by Athey Technologies of El Cerrito in 1986[4] and additional samples directly from CARB. The CalCoast study also evaluated performance parameters, as well as physically characterizing the formulations. Both labs made judgements as to the suitability of the formulations' performance characteristics.

As a follow-up to the CalCoast work, CARB requested proposals from analysis and testing labs in 1992, and the contract was awarded to the Contractor in 1993. This contract was divided into several phases, for management purposes, and a diagram of the program's phases is shown in Figure 1 (FLOW CHART - CALIFORNIA AIR RESOURCES BOARD CONTRACT NO. 92-339).

The Contractor utilized subcontractors to elicit assistance from California business owners for affirmative action. Thus, there was the need for the Contractor to monitor subcontractor activities.

SAMPLING AND SAMPLE PREPARATION

SELECTION OF MATERIALS

At the request of the California Air Resources Board personnel, a list of proposed products was submitted to aid in the compilation of products to be included in the test program. Final procurement lists included products proposed by the Contractor, various air quality district personnel, and CARB. Table 1 shows the categories proposed in the initial RFP by CARB for this contract. The categories were reconfigured and are shown in Table 2. The sample procurement process encompassed a 12 month period from initial submittal by the Contractor to receipt of the final procurement list from CARB.

TABLE 1

COATING CATEGORIES LISTED IN RFP AND PROPOSAL

Industrial Maintenance Coatings (Primers and Top Coats)
High Temperature Industrial Maintenance Coatings
Lacquers
MultiColor Coatings
Non-Flats (Interior and Exterior)
Primers, Sealers and Undercoaters
Sanding Sealers
Waterproofing Sealers

TABLE 2

FINAL LIST OF COATING CATEGORIES IN CONTRACT

Industrial Maintenance Coatings (Primers and Top Coats)
High Temperature Industrial Maintenance Coatings
Lacquers
Varnishes
Non-Flats (Interior and Exterior)
Primers, Sealers
Sanding Sealers
Waterproofing Sealers

PROCUREMENT OF MATERIALS

The materials were collected by the Contractor via purchase or direct submission from various manufacturers/suppliers throughout the United States, as directed by CARB. Some of the products were known to be non-compliant with regard to the VOC content, as regulated by the Bay Area Air Quality Management District, and did not fall under the small packaging (quart can) exemption. These non-compliant products were provided by the manufacturers for use by the Contractor under this contract only. For mutual protection, the Contractor affirms that these non-compliant products were not readily available for purchase in this district.

The products, as collected, were delivered in their original containers to CARB to be "blinded" and coded, to mask the origins of the materials. The "blind-coded" samples were then delivered to the Contractor to be divided into separate containers, in part for delivery to required subcontractors for their analyses.

The designated codes used by CARB and the Contractor are:

IMP Industrial Maintenance Primers
IMT Industrial Maintenance Topcoats
HTI High Temperature Industrial Maintenance Coatings
CWL Clear Wood Lacquers
VAR Varnishes
NFI Non-Flat Interior Coatings
NFE Non-Flat Exterior Coatings
PRS Primers/Sealers
SSE Sanding Sealers
WPS Waterproofing Sealers

Table 3 displays the sequence of activities by the Contractor and CARB during the management of the contract.

TABLE 3

SAMPLE DESIGNATION AND ACQUISITION SEQUENCE

CARB	DATE	CONTRACTOR
	10/18/93	Proposed Products List submitted to CARB
IMP, IMT Lists to Contractor	11/22/93	
	12/30/93	17 IMP/IMT Products delivered to CARB
CWL List to Contractor	01/12/94	
17 blind samples picked up from CARB	01/13/94	2 IMP/IMT Products delivered to CARB
NFE, NFI Lists to Contractor	01/14/94	
	02/11/94	27 IMP/IMT, NFI, NFE, CWL products delivered to CARB
29 blind samples pickup from CARB	02/24/94	11 IMP/IMT, NFI, NFE, CWL products delivered to CARB
HTI List to Contractor	02/25/94	
VAR List to Contractor	03/16/94	
11 blind samples picked up from CARB	03/30/94	14 NFI, CWL, HTI, VAR products delivered to CARB
	04/15/94	1 CWL product delivered to CARB
15 blind samples picked up from CARB	05/27/94	
PRS, WPS Lists to Contractor	06/22/94	
36 products blinded by CARB personnel at Contractor facility	08/30/94	36 CWL, PRS, WPS products delivered to CARB personnel at Contractor facility
SSE List to Contractor	10/26/94	
	11/16/94	5 SSE products delivered to CARB
5 blinded samples picked up from CARB	12/07/94	

SAMPLE INFORMATION (as collected from blinded data supplied with samples):

Industrial Maintenance Primers

CARB Identification	Solvent Classification	Binder Classification
IMP01 (A/B)	solvent-borne	epoxy, two-component
IMP02	water-borne	acrylic
IMP03	water-borne	acrylic
IMP04	water-borne	acrylic
IMP05	solvent-borne	alkyd, phenolic
IMP06	solvent-borne	alkyd
IMP07 (A/B)	water-borne	epoxy, two-component
IMP08	water-borne	acrylic
IMP09 (A/B)	water-borne	epoxy, two component
IMP10	solvent-borne	alkyd
IMP11	emulsion	acrylic
IMP12	solvent-borne	alkyd
IMP13	water-borne	acrylic

Industrial Maintenance Topcoats

CARB Identification	Solvent Classification	Binder Classification
IMT01	solvent-borne	alkyd
IMT02 (A/B)	water-borne	acrylic/epoxy, two-component
IMT03 (A/B)	solvent-borne	urethane, two-component
IMT04	solvent-borne	alkyd
IMT05	water-borne	acrylic
IMT06	water-borne	acrylic
IMT07	water-borne	acrylic
IMT08	solvent-borne	alkyd
IMT09	solvent-borne	alkyd
IMT10	water-borne	acrylic
IMT11 (A/B)	solvent-borne	epoxy, two-component
IMT12 (A/B)	solvent-borne	aliphatic acrylic urethane, two-component

High Temperature Industrial Maintenance Coatings

CARB Identification	Solvent Classification	Binder Classification
HTI02	solvent-borne	silicone, with alkyd
HTI03 (A/B)	solvent-borne	polysiloxane, two-component liquid/powder
HTI04 (A/B)	water-borne	potassium silicate, two-component liquid/zinc
HTI05	solvent-borne	silicone, zinc
HTI06	solvent-borne	silicone, aluminum

Clear Wood Coatings or Lacquers

CARB Identification	Solvent Classification	Binder Classification
CWL01	water-borne	not indicated
CWL02	solvent-borne	not indicated
CWL03	water-borne	polyurethane
CWL05	solvent-borne	not indicated
CWL06	water-borne	acrylic
CWL07	water-borne	acrylic/urethane
CLW09	water-borne	polyurethane modified acrylic
CWL10	solvent-borne	not indicated
CWL11	solvent-borne	alkyd modified lacquer
CWL12	solvent-borne	alkyd/nitrocellulose lacquer
CWL13	water-borne	not indicated
CWL14	solvent-borne	nitrocellulose/alkyd
CWL/SSE01	water-borne	acrylic (sealer)
CWL/SSE02	water-borne	acrylic (sealer)
CWL/SSE03	water-borne	acrylic (sealer)

Varnishes

CARB Identification	Solvent Classification	Binder Classification
VAR01	water-borne	polyurethane
VAR02	solvent-borne	tung phenolic
VAR03	solvent-borne	oil modified urethane
VAR04	water-borne	polyurethane
VAR05	solvent-borne	phenolic resin

Non-Flat Interiors

CARB Identification	Solvent Classification	Binder Classification
NFI01	water-borne	acrylic
NFI02	solvent-borne	alkyd
NFI03	water-borne	acrylic
NFI04	solvent-borne	alkyd
NFI05	water-borne	vinyl-acrylic
NFI06	water-borne	vinyl-acrylic
NFI07	water-borne	cross-linked acrylic
NFI08	water-borne	acrylic
NFI09	water-borne	acrylic
NFI10	water-borne	water reducible emulsion

Non-Flat Exteriors

CARB Identification	Solvent Classification	Binder Classification
NFE01	solvent-borne	alkyd
NFE02	water-borne	not indicated
NFE03	solvent-borne	urethane alkyd
NFE04	water-borne	alkyd modified acrylic
NFE05	water-borne	acrylic
NFE06	water-borne	vinyl-acrylic
NFE07	water-borne	urethane acrylic
NFE08	solvent-borne	alkyd
NFE09	solvent-borne	alkyd
NFE10	solvent-borne	alkyd

Primer/Sealers

CARB Identification	Solvent Classification	Binder Classification
PRS01	water-borne	not indicated
PRS02	water-borne	acrylic
PRS03	solvent-borne	alkyd
PRS04	solvent-borne	shellac
PRS05	solvent-borne	alkyd
PRS06	water-borne	not indicated
PRS07	solvent-borne	alkyd
PRS08	water-borne	"LATEX"
PRS09	water-borne	"LATEX"
PRS10	solvent-borne	alkyd
PRS11	water-borne	vinyl-acrylic
PRS12	water-borne	urethane modified acrylic
PRS13	solvent-borne	alkyd
PRS14	water-borne	acrylic
PRS15	water-borne	alkyd modified acrylic
PRS16	water-borne	alkyd modified acrylic
PRS17	water-borne	sytrene butadiene
PRS18	solvent-borne	alkyd
PRS19	solvent-borne	alkyd
PRS20	water-borne	"LATEX"

Sanding Sealers

CARB Identification	Solvent Classification	Binder Classification
SSE01	water-borne	not indicated
SSE02	solvent-borne	vinyl toluene alkyd
SSE03	solvent-borne	vinyl toluene alkyd
SSE04	water-borne	acrylic
SSE05	water-borne	acrylic

Waterproofing Sealers

CARB Identification	Solvent Classification	Binder Classification
WPS01	water-borne	not indicated
WPS02	solvent-borne	not indicated
WPS03	water-borne	modified linseed oil
WPS04	solvent-borne	not indicated
WPS05	water-borne	polyolefin resin
WPS06	water-borne	not indicated
WPS07	water/solvent	contains paraffin wax
WPS08 (A/B)	water-borne	silane & inorganic oligomers, two-component
WPS09	water-borne	alkylalkoxysilane, concentrate
WPS10	water-borne	alkylalkoxysilane
WPS11	water-borne	not indicated
WPS12	water-borne	not indicated
WPS13	water-borne	alkylalkoxysilane
WPS14	solvent-borne	alkoxy siloxane/silane
WPS15	water-borne	acrylic micro-emulsion/siloxane

MSDS* MANAGEMENT

Part of the blinding process included a MSDS for each sample. CARB personnel prepared a "blind" MSDS to accompany each product during transport for the analyst at the next destination. This "blind" MSDS had all informative data and warnings, but masked out all references to the actual manufacturer and product name. An original MSDS for each product was received in a sealed envelope with the CARB code marked on the outside of the envelope, so the Contractor would have no knowledge of its contents. These sealed CARB coded MSDS's were registered with CHEMTREC®, utilizing the CARB code, as a protection for transport workers and as required by the Department of Transportation for shipment of hazardous materials.

*MSDS - Material Safety Data Sheet, a federally mandated information sheet to accompany any chemical or chemical formulation, so that any person coming in contact with the material may be informed of any physical or toxicological threat that may be contained therein.

SAMPLE DIVISION

One important aspect of sample division was ensuring the homogeneity of each of the separate portions with respect to each other. Single component blind-coded samples were transferred/split into separately labeled quart and pint containers using ASTM D 3925 *Standard Practice for Sampling Liquid Paints and Related Pigmented Coatings* as a guide. Sample transfer was conducted to aid in compliance with the contract.

Samples were sent to the subcontractors for testing of volatile and water content, density, viscosity and storage stability. In addition to the blind coded MSDS, the Contractor's standard Sample Chain of Custody Record accompanied each sample shipment.

Two component blind-coded samples required special handling and testing was performed in the Contractor's laboratory.

TESTING

TEST PROTOCOL:

Test	Method	Parameters
Abrasion Resistance	ASTM D 4060	CS-17 calibrase wheels, 1 kg load weight loss per 1,000 cycles
Accelerated Weathering	ASTM G 53	300 hrs, cycle 4 hrs at 60°C UV, 4 hrs at 50°C Condensation, UVB-313 lamps
Accelerated Yellowing	FTMS 141, 6132 FTMS 141, 6131	non-flat interiors only yellowness index difference calculation
Adhesion	ASTM D 3359	Method B, cross-hatch
Alkali Resistance	ASTM D 1308	5% Sodium hydroxide, 1 hour open spot test
Appearance	FTMS 141, 4541	visual evaluation
Application Properties	FTMS 141, 2141.1 2112 or 2131.1	brush, roller or spray subjective evaluation
Bleed Resistance	TT-P-1984	western red cedar, 24 hours at 38°C and 100% relative humidity, change in Reflectance
Blocking Resistance	ASTM D 4946	30 minutes, 50 ± 2°C, 1 kg weight
Chemical Resistance	ASTM D 1308	Clear Wood Lacquers only, 2 hour covered spot test, distilled water and 50% alcohol, 18 hour recovery
Color change	FTMS 6131 evaluation ASTM G 23 exposure	Clear Wood Lacquers only, Yellowness index difference after 24 hrs exposure in open arc accelerated weathering
Condition in Container	ASTM D 3925	as received
Density	ASTM D 1475	g/ml, 25 ± 0.2°C
Dry Film Thickness	ASTM D 1186 or ASTM D 1400	per manufacturer's recommendation
Dry opacity	FTMS 141, 4121.1	Method B, 9.81 m^2/L (400 ft^2/gal)
Dry Time	ASTM D 1640	23 ± 2°C, per manufacturer's recommended wet film thickness
Enamel Hold Out	TT-E-543	on glass, TT-E-508 topcoat, 48 hour dry between coats; change in 60° Gloss

Flexibility	ASTM D 522	18 hr air dry, 3 hr bake at 105°C 6.4mm (1/4 in.) cylindrical mandrel
Freeze-Thaw Resistance	ASTM D 2243	3 cycles, water-borne products
Fungus Resistance	FTMS 141, 6271.2	aspergillus niger, no leaching, 7 days incubation at 28°C and 85% Relative Humidity
Gloss	ASTM D 523	60°, 48 hour dry or as indicated
Grain Raising of Wood	subjective	on ponderosa pine and/or walnut veneer
Hardness, Pencil	ASTM D 3363	Gouge (hardest pencil to leave film uncut); Scratch (hardest pencil not to rupture or scratch film) (softest) 6B to 6H (hardest)
Impact Resistance	ASTM D 2794	direct, 80 inch pounds maximum test load, or load at failure
Non-volatile	ASTM D 2369	% by wt., 1 hour, 110°C ± 5°C
Reflectance	ASTM E 97	45°/0° daylight luminous directional
Sag Resistance	ASTM D 4400	procedure A, ratings of 3 (heavy sagging) to 12 (no sagging)
Salt Spray	ASTM B 117 ASTM D 1654	168 hours exposure panel evaluation
Sanding Properties	FTMS 141c, 6321	straight grain walnut veneer
Scrub Resistance	ASTM D 2486	400 cycles, abrasive scrub medium, 5/4 patterned brush
Stability	ASTM D 1849	30 days, 49 ± 1°C, viscosity reported
Viscosity	ASTM D 562	Krebs Units, 25 ± 0.2°C
VOC	ASTM D 3960	calculation, g/L
Water Absorption	SS-W-110b	72 hour immersion, 1/4 inch depth, calculate percent water absorbed
Water Content	ASTM D 3792 ASTM D 4017	% by wt., water reducible coatings % by wt., solvent reducible coatings
Water Immersion	ASTM D 870	18 hours, 38°C
Water Repellency	ASTM D 1308	1 hour open spot test
Water Resistance	ASTM D 1647	18 hours, 25°C for Varnishes only
Wind Driven Rain	TT-C-555B	concrete block, WPS08a/b & WPS09 waterproofing sealers only

SUBCONTRACTOR TESTING

As proposed, and in accordance with California Public Contract Code Section 10115 et seq. and Military and Veterans Code Section 999 et seq., the Contractor committed to utilize the services of Minority Business Enterprise, Women Business Enterprise, and Disabled Veteran Business Enterprise subcontractors.

Three subcontractors were utilized for actual testing. Subcontractor One[5] calculated the VOC contents in single component samples, after determination of the volatiles, density and water content. Subcontractor Two[6] was employed to determine the viscosity of single component samples. Subcontractor Three[7] conducted storage stability exposure testing of wet samples and salt spray testing of Contractor-prepared panels submitted.

IN-HOUSE TESTING

Samples for testing included 11 two-component products: eight products having two liquid components; two products having 1 powder, 1 liquid component; and 1 concentrate. Due to the special handling required, these 11 two-component samples remained in-house for complete testing. In addition to the two-component samples, all sanding sealers were kept in-house for complete testing due to the time frame for testing and contract completion. The balance of testing in each category, not conducted by the subcontractors, was completed at the Contractor's laboratory, utilizing test methods cited or developed by the American Society for Testing and Materials (ASTM), Federal Test Method Standards (FTMS), Federal Specifications, and the Contractor. Not every test was pertinent to every sample. The following is a listing of tests performed under each coating category.

Industrial Maintenance Primers:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Application Properties	Adhesion
Hardness	Appearance	Flexibility
Dry Time	Salt Spray	Impact Resistance
Freeze-Thaw Resistance	Water Immersion	

Industrial Maintenance Topcoats:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Application Properties	Adhesion
Hardness	Appearance	Flexibility
Dry Time	Salt Spray	Accelerated Weathering
Impact Resistance	Freeze-Thaw Resistance	Abrasion Resistance
Gloss	Contrast Ratio/Dry Opacity	

High Temperature Industrial Maintenance Coatings:

Condition in Container	Non-volatile	Density
Viscosity (KU)	Water Content	VOC
Stability	Hardness	Application Properties
Adhesion	Dry Time	Appearance
Abrasion Resistance	Flexibility	Impact Resistance
Accelerated Weathering	Salt Spray	Gloss
Heat Resistance	Water Immersion	

Clear Wood Coatings or Lacquers:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Freeze-Thaw Resistance	Blocking Resistance
Application Properties	Adhesion	Dry Time
Appearance	Flexibility	Impact Resistance
Gloss	Grain Raising of Wood	Yellowness index
Sanding Properties (sealers only)	Cold Check Resistance	Print Resistance
Chemical Resistance	Color of Dried Film	

Varnishes:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Freeze-Thaw Resistance	Hardness
Application Properties	Adhesion	Dry Time
Appearance	Abrasion Resistance	Flexibility
Gloss	Grain Raising of Wood	Water Resistance

Non-Flat Exterior Coatings:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Freeze-Thaw Resistance	Hardness
Blocking Resistance	Application Properties	Adhesion
Dry Time	Appearance	Abrasion Resistance
Flexibility	Impact Resistance	Accelerated Weathering
Fungus Resistance	Gloss	Sag Resistance
Contrast Ratio/Dry Opacity		

Non-Flat Interior Coatings:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Freeze-Thaw Resistance	Hardness
Blocking Resistance	Application Properties	Adhesion
Dry Time	Appearance	Flexibility
Scrub Resistance	Fungus Resistance	Gloss
Accelerated Yellowing	Contrast Ratio/Dry Opacity	Sag Resistance

Primers/Sealers:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Freeze-Thaw Resistance	Application Properties
Adhesion	Dry Time	Appearance
Flexibility	Grain Raising of Wood	Sag Resistance
Sanding Properties	Enamel Hold Out	Bleed Resistance
Alkali Resistance		

Sanding Sealers:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Freeze-Thaw Resistance	Application Properties
Adhesion	Dry Time	Appearance
Flexibility	Grain Raising of Wood	Sanding Properties

Waterproofing Sealers:

Condition in Container	Non-volatile	Density
Viscosity	Water Content	VOC
Stability	Application Properties	Appearance
Accelerated Weathering	Water Repellency	Water Absorption

TESTING RESULTS

The test results are recorded on a standard test report form. These report forms are replicated in the appendices showing the results for each of the sample sets.

PROGRAM MANAGEMENT

This contract was divided into several phases, for management purposes, and a diagram of the program's phases is shown in Figure 1 (FLOW CHART - CALIFORNIA AIR RESOURCES BOARD CONTRACT NO. 92-339).

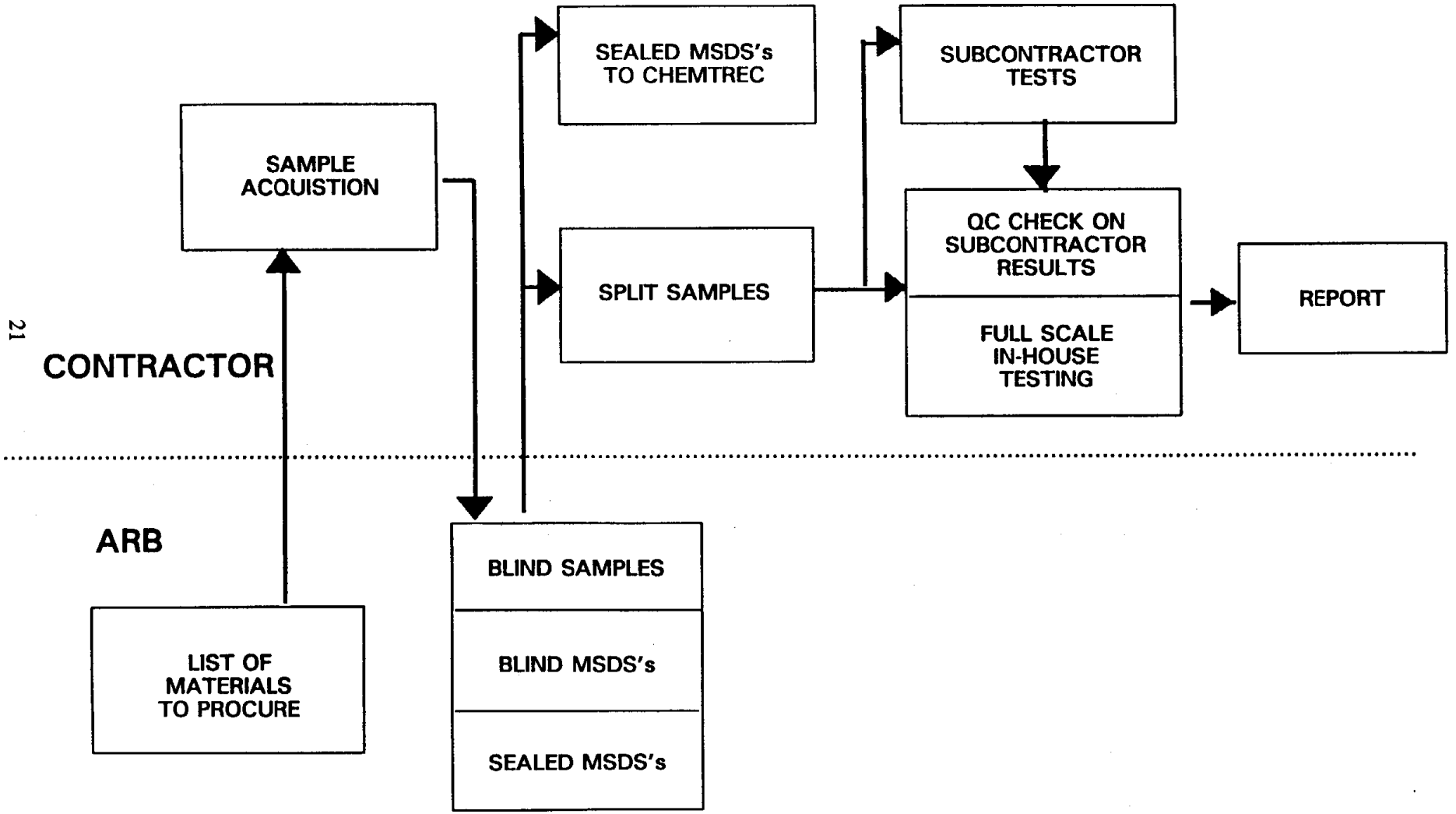
USE OF SUBCONTRACTORS

Program management of the subcontractors in this contract included inspection of subcontractor facilities, quality control/cross check analyses by the Contractor, and frequent discussions to maintain excellence in analysis and reporting.

QUALITY ASSESSMENT FOR TESTING SUBCONTRACTORS

A minimum of 20% of subcontracted testing was duplicated by the Contractor. Data analysis of Subcontractor and Contractor test results for non-volatile, viscosity, density and water content determinations were within the precision limits cited by the respective ASTM methods. Salt spray test results were comparable; however, no specific precision limits are cited in the ASTM method.

FLOW CHART
CALIFORNIA AIR RESOURCES BOARD
CONTRACT NO. 92-339
FIGURE 1



REFERENCES

1. CARB Contract No. A0-075-31, "Evaluation of A. Interior Wall Enamels, B. Sealing Qualities of Interior Wall Primers", DL Laboratories, 1 April 1981

2. CARB Contract No. A2-052-32, "Evaluation of Properties of Varnishes, Exterior Stains, Exterior Primers", DL Laboratories, June 1984.

3. CARB Contract No. A4-166-48, "Testing and Evaluation of Specialty Architectural Coatings", CalCoast Analytical Labs, 3 April 1987

4. CARB Contract No. A5-097-48, "Third Party Selection and Processing of Architectural Coatings for Testing", Athey Technologies, 30 April 1986

5. Subcontractor 1: Calscience Environmental Laboratories, Inc., Stanton, California.

6. Subcontractor 2: American Research & Testing, Inc., Gardena, California.

7. Subcontractor 3: S.E. Laboratories, Inc., Santa Clara, California

TEST	INDUSTRIAL MAINTENANCE PRIMERS												
	IMP01a/b	IMP02	IMP03	IMP04	IMP05	IMP06	IMP07a/b	IMP08	IMP09a/b	IMP10	IMP11	IMP12	IMP13
VOC (g/L)*	306	174	215	143	462	305	190	120	232	325	64	472	90
Total Non-volatile (% by wt)*	81.1	47.9	47.7	44.6	65.7	77.9	49.5	54.3	52.7	80.3	54.4	60.0	60.8
Density (g/ml)*	1.621	1.220	1.163	1.170	1.346	1.379	1.212	1.321	1.302	1.652	1.289	1.181	1.338
Viscosity (KU)**	88	90	90	91	98	76	98	104	85	102	95	83	101
Water Content (% by wt)	0.33	45.8*	43.1*	50.4*	1.21	0.32	43.0	41.6*	38.4	0.08	43.4*	0.25	35.7*
Stability (KU)***	87	89	89	83	113	74	94	112	A: fail B: N/C	90	105	78	103
Freeze-Thaw Resistance	N/A	fail	fail	99	N/A	N/A	A: fail B: fail	106	A: N/C B: fail	N/A	99	N/A	fail
Hardness: Scratch	5H	B	3B	3B	HB	HB	HB	F	2H	3H	B	HB	B
Gouge	6H	HB	HB	3B	HB	H	HB	F	2H	3H	B	HB	B
Application Properties	satisfactory	good	good	pinholes develop after 5 min.	satisfactory, using high pressure	good	excellent	excellent	excellent	satisfactory	fair; slight cratering	excellent	excellent
Adhesion	4B	5B	5B	5B	1B	5B	5B	5B	3B	2B	4B	5B	5B
Dry Time: Set-to-touch	1hr,25min	1 hr.	1/3 hr.	1/2 hr.	1/2 hr.	2 hr.	35 min.	1/3 hr.	1 hr.	1/3 hr.	1 hr.	1hr.	2/3 hr.
Dry hard	4hr,25min	3 hrs.	1 hr.	1 hr.	2 hr.	6hrs.	1hr10min	1/2 hr.	2¾ hrs.	3/4 hr.	4 hrs.	4hrs.	4 hrs.
to recoat	OK,8 hrs	OK,4hrs	OK,3 hrs	OK,4 hrs	OK,2hrs.	OK,24hrs	OK,6hrs.	OK,1/2hr	OK,16hrs	OK,16hrs	OK,8 hrs	OK24hr	OK,4hrs
Appearance	slight gloss/ orange peel	good, uniform	slight gloss, uniform	fine seeded texture	orange peel pinholing	slight gloss, orange peel	uniform, slight gloss	excellent	good; uniform	orange peel	uniform; craters	excellent	good; smooth
Flexibility, 1/4" mandrel	fail	pass	pass	pass	fail	pass	pass	pass	pass	fail	pass	pass	pass
Impact Resistance (inch pounds)	pass, 80	pass, 80	pass, 80	pass, 80	fail, 20	pass, 80	pass, 80	pass, 80	pass, 80	fail, 20	pass, 80	pass, 80	pass, 80
Salt Spray***:scribed area	10	10	8	9	10	10	10	9	10	10	10	10	10
unscribed area	10	10	8	0	10	10	10	6	10	10	1	10	10
Water Immersion	no effect	lightening, recovers 2 hrs	lightening & blistering	lightening, no recovery	no effect	slight whitening	lightening blistering 1/3 surface	blistering	lightening	lightening	blistering	lightening; 2hr recovery	lightening; 2hr recovery

a/b two component sample
* tests conducted by Subcontractor 1 on single component samples
** tests conducted by Subcontractor 2 on single component samples
*** exposure tests conducted by Subcontractor 3 on single component samples with evaluation by Contractor

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP01a/IMP01b

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: hard packed Component B: hard packed each mixes to homogenous state by mechanical methods
Total Non-volatile	ASTM D 2369	81.1% by wt.
Density	ASTM D 1475	1.621 g/ml
Viscosity	ASTM D 562	88 KU
Water	ASTM D 4017	0.33 % by wt.
VOC	ASTM D 3960	306 g/L
Stability	ASTM D 1849	87 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch 5H, Gouge 6H
Application Properties	FTMS 141c, 2131.1	satisfactory
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 1 hr., 25 min. dry hard: 4 hrs., 25 min. to recoat: OK, 8 hrs.
Appearance	FTMS 141C, 4541	slight gloss & orange peel
Flexibility	ASTM D 522	fails
Impact Resistance, direct	ASTM D 2794	passes, 80 inch pounds
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	no effect

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP02

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	47.9% by wt.
Density	ASTM D 1475	1.220 g/ml
Viscosity	ASTM D 562	90 KU
Water	ASTM D 3792	45.8% by wt.
VOC	ASTM D 3960	174 g/L
Stability	ASTM D 1849	89 KU
Freeze-Thaw Resistance	ASTM D 2243	fail
Hardness	ASTM D 3363	Scratch B, Gouge HB
Application Properties	FTMS 141c, 2131.1	good
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 1 hr. dry hard: 3 hrs. to recoat: OK, 4 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evalution	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	lightening, recovers 2 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP03

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	47.7% by wt.
Density	ASTM D 1475	1.163 g/ml
Viscosity	ASTM D 562	90 KU
Water	ASTM D 3792	43.1% by wt.
VOC	ASTM D 3960	215 g/L
Stability	ASTM D 1849	89 KU
Freeze-Thaw Resistance	ASTM D 2243	fail
Hardness	ASTM D 3363	Scratch 3B, Gouge HB
Application Properties	FTMS 141c, 2131.1	good
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 1/3 hr. dry hard: 1 hr. to recoat: OK, 3 hrs.
Appearance	FTMS 141C, 4541	slight gloss, uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 8 unscribed area: 8
Water Immersion	ASTM D 870	lightening & blistering

LABORATORY TEST RESULTS

CLIENT CALIFORNIA AIR RESOURCES BOARD DATE RECD 03-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP04

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	44.6% by wt.
Density	ASTM D 1475	1.170 g/ml
Viscosity	ASTM D 562	91 KU
Water	ASTM D 3792	50.4% by wt.
VOC	ASTM D 3960	143 g/L
Stability	ASTM D 1849	83 KU
Freeze-Thaw Resistance	ASTM D 2243	99 KU
Hardness	ASTM D 3363	Scratch 3B, Gouge 3B
Application Properties	FTMS 141c, 2131.1	pinholes develop 5 minutes after application
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 1/2 hr dry hard: 1.0 hr. to recoat: OK, 4 hrs.
Appearance	FTMS 141C, 4541	finely seeded texture
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 9 unscribed area: 0
Water Immersion	ASTM D 870	lightening

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP05

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	65.7% by wt.
Density	ASTM D 1475	1.346 g/ml
Viscosity	ASTM D 562	98 KU
Water	ASTM D 4017	1.21% by wt.
VOC	ASTM D 3960	462 g/L
Stability	ASTM D 1849	113 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch HB, Gouge HB
Application Properties	FTMS 141c, 2131.1	satisfactory, using high pressure
Adhesion	ASTM D 3359	1B
Dry Time	ASTM D 1640	set-to-touch: 1/2 hr. dry hard: 2 hr. to recoat: OK, 2 hrs.
Appearance	FTMS 141C, 4541	orange peel, fine pinholing
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	fail, 20 in. lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	no effect

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP06

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	77.9% by wt.
Density	ASTM D 1475	1.379 g/ml
Viscosity	ASTM D 562	76 KU
Water	ASTM D 4017	0.32% by wt.
VOC	ASTM D 3960	305 g/L
Stability	ASTM D 1849	74 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch HB, Gouge H
Application Properties	FTMS 141c, 2131.1	good
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 2 hrs. dry hard: 6 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	slight gloss & orange peel
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	slight whitening

LABORATORY TEST RESULTS

CLIENT CALIFORNIA AIR RESOURCES BOARD DATE RECD 01-13-94 OUR FILE P - 9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP07a/IMP07b

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: soft packed Component B: hard packed each mixes to homogenous state by mechanical methods
Total Non-volatile	ASTM D 2369	49.5% by wt.
Density	ASTM D 1475	1.212 g/ml
Viscosity	ASTM D 562	98 KU
Water	ASTM D 3792	43.0% by wt.
VOC	ASTM D 3960	190 g/L
Stability	ASTM D 1849	94 KU
Freeze-Thaw Resistance	ASTM D 2243	Component A: fail Component B: fail
Hardness	ASTM D 3363	Scratch HB, Gouge HB
Application Properties	FTMS 141c, 2131.1	excellent
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 35 min. dry hard: 1 hr., 10 min. to recoat: OK, 6 hrs.
Appearance	FTMS 141C, 4541	uniform, slight gloss
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	lightening, blistering 1/3 of exposed surface

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP08

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	54.3% by wt.
Density	ASTM D 1475	1.321 g/ml
Viscosity	ASTM D 562	104 KU
Water	ASTM D 3792	41.6% by wt.
VOC	ASTM D 3960	120 g/L
Stability	ASTM D 1849	112 KU
Freeze-Thaw Resistance	ASTM D 2243	106 KU
Hardness	ASTM D 3363	Scratch F, Gouge F
Application Properties	FTMS 141c, 2131.1	excellent
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 20 min. dry hard: 30 min. to recoat: OK, 30 min.
Appearance	FTMS 141C, 4541	excellent
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lbs.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 9 unscribed area: 6
Water Immersion	ASTM D 870	blistering

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP09a/IMP09b

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: soft packed Component B: hard packed each mixes to homogenous state by mechanical methods
Total Non-volatile	ASTM D 2369	52.7% by wt.
Density	ASTM D 1475	1.302 g/ml
Viscosity	ASTM D 562	85 KU
Water	ASTM D 3792	38.4% by wt.
VOC	ASTM D 3960	232 g/L
Stability	ASTM D 1849	Component A: fails Component B: no change mixing not feasible
Freeze-Thaw Resistance	ASTM D 2243	Component A: no change Component B: fails mixing not feasible
Hardness	ASTM D 3363	Scratch 2H, Gouge 2H
Application Properties	FTMS 141c, 2131.1	excellent
Adhesion	ASTM D 3359	3B
Dry Time	ASTM D 1640	set-to-touch: 1 hr. dry hard: 2-3/4 hrs. to recoat: OK, 16 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	lightening

LABORATORY TEST RESULTS

CLIENT CALIFORNIA AIR RESOURCES BOARD DATE RECD 01-13-94 OUR FILE P - 9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP10

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	slight settling, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	80.3% by wt.
Density	ASTM D 1475	1.652 g/ml
Viscosity	ASTM D 562	102 KU
Water	ASTM D 4017	0.08% by wt.
VOC	ASTM D 3960	325 g/L
Stability	ASTM D 1849	90 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch 3H, Gouge 3H
Application Properties	FTMS 141c, 2131.1	satisfactory
Adhesion	ASTM D 3359	2B
Dry Time	ASTM D 1640	set-to-touch: 20 min. dry hard: 45 min. to recoat: OK, 16 hrs.
Appearance	FTMS 141C, 4541	orange peel
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	fails, 20 in. lb.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	lightening

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP11

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	54.4% by wt.
Density	ASTM D 1475	1.289 g/ml
Viscosity	ASTM D 562	95 KU
Water	ASTM D 3792	43.4% by wt.
VOC	ASTM D 3960	64 g/L
Stability	ASTM D 1849	105 KU
Freeze-Thaw Resistance	ASTM D 2243	99 KU
Hardness	ASTM D 3363	Scratch B, Gouge B
Application Properties	FTMS 141c, 2131.1	fair, slight cratering
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 1 hr. dry hard: 4 hrs. to recoat: OK, 8 hrs.
Appearance	FTMS 141C, 4541	uniform, minute craters
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 1
Water Immersion	ASTM D 870	blistering

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP12

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	60.0% by wt.
Density	ASTM D 1475	1.181 g/ml
Viscosity	ASTM D 562	83 KU
Water	ASTM D 4017	0.25% by wt.
VOC	ASTM D 3960	472 g/L
Stability	ASTM D 1849	78 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch HB, Gouge HB
Application Properties	FTMS 141c, 2131.1	excellent
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 1 hr. dry hard: 4 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	excellent
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	lightens, 2 hr. recovery

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMP13

COATING CATEGORY: INDUSTRIAL MAINTENANCE PRIMERS

TESTS	TEST METHOD	RESULT
Condition in container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	60.8% by wt.
Density	ASTM D 1475	1.338 g/ml
Viscosity	ASTM D 562	101 KU
Water	ASTM D 3792	35.7% by wt.
VOC	ASTM D 3960	90 g/L
Stability	ASTM D 1849	103 KU
Freeze-Thaw Resistance	ASTM D 2243	fail
Hardness	ASTM D 3363	Scratch B, Gouge B
Application Properties	FTMS 141c, 2131.1	excellent
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 40 min. dry hard: 4 hrs. to recoat: OK, 4 hrs.
Appearance	FTMS 141C, 4541	good: smooth
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Water Immersion	ASTM D 870	lightening, recover 2 hrs.

TEST	INDUSTRIAL MAINTENANCE TOPCOATS											
	IMT01	IMT02a/b	IMT03a/b	IMT04	IMT05	IMT06	IMT07	IMT08	IMT09	IMT10	IMT11a/b	IMT12a/b
VOC (g/L)*	370	243	252	412	229	173	163	470	274	230	266	335
Total Non-volatile (% by wt)*	69.2	54.3	82.7	60.8	46.1	48.2	45.4	55.7	77.3	46.7	82.7	73.0
Density (g/ml)*	1.201	1.250	1.454	1.050	1.161	1.161	1.179	1.060	1.208	1.176	1.536	1.241
Viscosity (KU)**	73	73	89	90	86	102	102	97	88	91	104	80
Water Content (% by wt)	0.14	34.7	0.28	0.13	44.3*	44.6*	48.7*	0.05	0.15	43.8*	0.34	0.24
Stability (KU)***	70	62	89	79	78	101	108	104	91	88	107	76
Freeze-Thaw Resistance (KU)	N/A	62	N/A	N/A	84	106	103	N/A	N/A	fail	N/A	N/A
Hardness: Scratch Gouge	B HB	HB F	3B HB	5B HB	2B HB	5B HB	5B 5B	3B 2B	4B 3B	<6B HB	>6H >6H	H >6H
Application Properties	satisfactory	good	satisfactory	good	excellent	good; 6% reduction	satisfactory; 6% reduction	excellent; 12% reduction	excellent	excellent	poor by spray; good by brush	good
Adhesion	3B	3B	5B	4B	5B	5B	3B	4B	4B	5B	4B	4B
Dry Time: Set-to-touch Dry hard to recoat	1/4 hr. 1 hr. OK,30 hrs	1/3 hr. 1hr,10min OK, 3 hrs.	2 1/4 hr. 7 3/4 hr. OK,24hr.	2 hrs. 4 hrs. OK,8 hrs	18 min. 3/4 hr. OK,1hrs.	1 hr. 4 hrs. OK,4hrs.	2 hrs. 4 hrs. OK,4hrs	2 hrs. 4 hrs. OK,24hrs	4-1/2 hrs 6 hrs. OK,24hrs	1/3 hr. 1 hr. OK,3hrs	3 hrs. 8 hrs. OK,12 hrs	35 min. 4-1/4hrs OK,24hrs
Appearance	glossy; slight orange peel	fair; extra fine pinholing	good; slight orange peel	good; slight orange peel	good; uniform	good; uniform	poor; orange peel and pinholes	excellent; uniform	good; uniform	fair; uniform, minute pinholing	sprayed, poor; brushed, fair	good; slight peel
Abrasion Resistance (mg)	195	111	48	145	63	90	149	122	72	96	153	41
Flexibility, 1/4" mandrel	fail	pass	pass	pass	pass	pass	pass	pass	pass	pass	fail	pass
Impact Resistance (inch pounds)	fail, 20	pass, 56	pass, 80	pass, 80	pass, 80	pass, 80	pass, 80	pass, 60	pass, 80	pass, 80	pass, 60	pass, 80
Accelerated Weathering: Reflectance Gloss	 - 11 units - 58 units	 - 10 units no change	 no change - 48 units	 no change - 25 units	 no change - 16 units	 no change - 47 units	 no change - 24 units	 + 2 units - 41 units	 + 2 units - 49 units	 - 5 units - 36 units	 no change - 50 units	 n/c - 2 units
Salt Spray***: scribed area unscribed area	8 3	8 10	10 10	10 10	10 10	10 10	10 8	9 10	9 10	9 2	10 10	10 10
Gloss	89	31	75	78	74	71	72	92	92	36	50	92
Contrast Ratio/Dry Opacity	0.98	0.94	0.96	0.93	0.97	0.94	0.95	0.98	0.99	0.92	0.95	0.97

a/b two component sample

* tests conducted by Subcontractor 1 on single component samples

** tests conducted by Subcontractor 2 on single component samples

*** exposure tests conducted by Subcontractor 3 on single component samples with evaluation by Contractor

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT01

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	69.2% by wt.
Density	ASTM D 1475	1.201 g/ml
Viscosity	ASTM D 562	73 KU
Water	ASTM D 4017	0.14% by wt.
VOC	ASTM D 3960	370 g/L
Stability	ASTM D 1849	70 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch B, Gouge HB
Application Properties	FTMS 141c, 2131.1	satisfactory
Adhesion	ASTM D 3359	3B
Dry Time	ASTM D 1640	set-to-touch: 15 min. dry hard: 1 hr. to recoat: OK, 30 hrs.
Appearance	FTMS 141C, 4541	glossy, slight orange peel
Abrasion Resistance	ASTM D 4060	195 mg
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	fail, 20 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 11 unit decrease Gloss: 58 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 8 unscribed area: 3
Gloss	ASTM D 523	89
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.98

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT02a/IMT02b

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: soft packed, mixes readily to homogenous state Component B: clear
Total Non-volatile	ASTM D 2369	54.3% by wt.
Density	ASTM D 1475	1.250 g/ml
Viscosity	ASTM D 562	73 KU
Water	ASTM D 3792	34.7% by wt.
VOC	ASTM D 3960	243 g/L
Stability	ASTM D 1849	62 KU
Freeze-Thaw Resistance	ASTM D 2243	62 KU
Hardness	ASTM D 3363	Scratch HB, Gouge F
Application Properties	FTMS 141c, 2131.1	good
Adhesion	ASTM D 3359	3B
Dry Time	ASTM D 1640	set-to-touch: 20 min. dry hard: 1 hr., 10 min. to recoat: OK, 3 hrs.
Appearance	FTMS 141C, 4541	fair, extra fine pinholing
Abrasion Resistance	ASTM D 4060	111 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 56 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 10 unit decrease Gloss: no change
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 8 unscribed area: 10
Gloss	ASTM D 523	31
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.94

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 03-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT03a/IMT03b

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: soft packed, mixes readily to homogenous state Component B: clear
Total Non-volatile	ASTM D 2369	82.7% by wt.
Density	ASTM D 1475	1.454 g/ml
Viscosity	ASTM D 562	89 KU
Water	ASTM D 4017	0.28 % by wt.
VOC	ASTM D 3960	252 g/L
Stability	ASTM D 1849	89 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch 3B, Gouge HB
Application Properties	FTMS 141c, 2131.1	satisfactory
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 2-1/4 hrs. dry hard: 7-3/4 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	good: slight orange peel
Abrasion Resistance	ASTM D 4060	48 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 48 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	75
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.96

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT04

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogeneous, mixes readily
Total Non-volatile	ASTM D 2369	60.8% by wt.
Density	ASTM D 1475	1.050 g/ml
Viscosity	ASTM D 562	90 KU
Water	ASTM D 4017	0.13% by wt.
VOC	ASTM D 3960	412 g/L
Stability	ASTM D 1849	79 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch 5B, Gouge HB
Application Properties	FTMS 141c, 2131.1,	good
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 2 hrs. dry hard: 4 hrs. to recoat: OK, 8 hrs.
Appearance	FTMS 141C, 4541	good: slight orange peel
Abrasion Resistance	ASTM D 4060	145 mg
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 25 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	78
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.93

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT05

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	46.1% by wt.
Density	ASTM D 1475	1.161 g/ml
Viscosity	ASTM D 562	86 KU
Water	ASTM D 3792	44.3% by wt.
VOC	ASTM D 3960	229 g/L
Stability	ASTM D 1849	78 KU
Freeze-Thaw Resistance	ASTM D 2243	84 KU
Hardness	ASTM D 3363	Scratch 2B, Gouge HB
Application Properties	FTMS 141c, 2131.1,	excellent
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 18 min. dry hard: 45 min. to recoat: OK, 1 hr.
Appearance	FTMS 141C, 4541	good: uniform
Abrasion Resistance	ASTM D 4060	63 mg
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 16 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	74
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.97

LABORATORY TEST RESULTS

CLIENT CALIFORNIA AIR RESOURCES BOARD DATE RECD 01-13-94 OUR FILE P - 9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT06

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	48.2% by wt.
Density	ASTM D 1475	1.161 g/ml
Viscosity	ASTM D 562	102 KU
Water	ASTM D 3792	44.6% by wt.
VOC	ASTM D 3960	173 g/L
Stability	ASTM D 1849	101 KU
Freeze-Thaw Resistance	ASTM D 2243	106 KU
Hardness	ASTM D 3363	Scratch 5B, Gouge HB
Application Properties	FTMS 141c, 2131.1	good, 6% reduction (by vol.)
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 1 hr. dry hard: 4 hrs. to recoat: OK, 4 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Abrasion Resistance	ASTM D 4060	90 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 47 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	71
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.94

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT07

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	45.4% by wt.
Density	ASTM D 1475	1.179 g/ml
Viscosity	ASTM D 562	102 KU
Water	ASTM D 3792	48.7% by wt.
VOC	ASTM D 3960	163 g/L
Stability	ASTM D 1849	108 KU
Freeze-Thaw Resistance	ASTM D 2243	103 KU
Hardness	ASTM D 3363	Scratch 5B, Gouge 5B
Application Properties	FTMS 141c, 2131.1	satisfactory, 6% reduction (by vol.)
Adhesion	ASTM D 3359	3B
Dry Time	ASTM D 1640	set-to-touch: 2 hrs. dry hard: 4 hrs. to recoat: OK, 4 hrs.
Appearance	FTMS 141C, 4541	poor, orange peel & pinholes
Abrasion Resistance	ASTM D 4060	149 mg
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 24 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 8
Gloss	ASTM D 523	72
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.95

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT08

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	some lumpy material, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	55.7% by wt.
Density	ASTM D 1475	1.060 g/ml
Viscosity	ASTM D 562	97 KU
Water	ASTM D 4017	0.05% by wt.
VOC	ASTM D 3960	470 g/L
Stability	ASTM D 1849	104 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch 3B, Gouge 2B
Application Properties	FTMS 141c, 2131.1	excellent, 12% reduction (by vol.)
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 2 hrs. dry hard: 4 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	excellent: uniform
Abrasion Resistance	ASTM D 4060	122 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 60 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 2 unit increase Gloss: 41 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 9 unscribed area: 10
Gloss	ASTM D 523	92
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.98

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 01-13-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT09

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	slightly settled, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	77.3% by wt.
Density	ASTM D 1475	1.208 g/ml
Viscosity	ASTM D 562	88 KU
Water	ASTM D 4017	0.15% by wt.
VOC	ASTM D 3960	274 g/L
Stability	ASTM D 1849	91 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch 4B, Gouge 3B
Application Properties	FTMS 141c, 2131.1	excellent
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 4-1/2 hrs. dry hard: 6 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Abrasion Resistance	ASTM D 4060	72 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 2 unit increase Gloss: 49 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 9 unscribed area: 10
Gloss	ASTM D 523	92
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.99

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT10

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous, mixes readily
Total Non-volatile	ASTM D 2369	46.7% by wt.
Density	ASTM D 1475	1.176 g/ml
Viscosity	ASTM D 562	91 KU
Water	ASTM D 3792	43.8% by wt.
VOC	ASTM D 3960	230 g/L
Stability	ASTM D 1849	88 KU
Freeze-Thaw Resistance	ASTM D 2243	fail
Hardness	ASTM D 3363	Scratch <6B, Gouge HB
Application Properties	FTMS 141c, 2131.1,	excellent
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 20 min. dry hard: 1 hr. to recoat: OK, 3 hrs.
Appearance	FTMS 141C, 4541	fair: uniform, minute pinholing
Abrasion Resistance	ASTM D 4060	96 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 5 unit decrease Gloss: 36 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 9 unscribed area: 2
Gloss	ASTM D 523	36
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.92

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT11a/IMT11b

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: homogenous Component B: hard packed mixed to homogenous state by mechanical methods
Total Non-volatile	ASTM D 2369	82.7% by wt.
Density	ASTM D 1475	1.536 g/ml
Viscosity	ASTM D 562	104 KU
Water	ASTM D 4017	0.34% by wt.
VOC	ASTM D 3960	266 g/L
Stability	ASTM D 1849	107 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch >6H, Gouge >6H
Application Properties	FTMS 141c, 2131.1	poor by spray (12% max. reduction), good by brush
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 3 hrs. dry hard: 8 hrs. recoat: OK, 12 hrs.
Appearance	FTMS 141C, 4541	sprayed - poor, craters brushed - fair (brush marks)
Abrasion Resistance	ASTM D 4060	153 mg.
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	pass, 60 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 50 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	50
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.95

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION IMT12a/IMT12b

COATING CATEGORY: INDUSTRIAL MAINTENANCE TOPCOATS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: homogenous Component B: homogenous
Total Non-volatile	ASTM D 2369	73.0% by wt.
Density	ASTM D 1475	1.241 g/ml
Viscosity	ASTM D 562	80 KU
Water	ASTM D 4017	0.24% by wt.
VOC	ASTM D 3960	335 g/L
Stability	ASTM D 1849	76 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Hardness	ASTM D 3363	Scratch H, Gouge >6H
Application Properties	FTMS 141c, 2131.1	good
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 35 min. dry hard: 4-1/4 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	good: slight orange peel
Abrasion Resistance	ASTM D 4060	41 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: 2 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	92
Contrast Ratio/Dry Opacity	FTMS 141C, 4121.1	0.97

TEST	HIGH TEMPERATURE INDUSTRIAL MAINTENANCE COATINGS				
	HTI02	HTI03a/b	HTI04a/b	HTI05	HTI06
VOC (g/L)*	599	273	31	289	548
Total Non-volatile (% by wt)*	44.3	85.7	78.8	90.3	44.8
Density (g/ml)*	1.075	1.908	2.949	2.976	0.992
Viscosity (KU)**	68	70	82	102	55
Water Content (% by wt)	0.05	<0.01	20.8	0.15	0.06
Stability (KU)***	73	70	82	104	54
Hardness: Scratch Gouge	>6H >6H	>6H >6H	5H 3H	F H	5H 5H
Application Properties	spray: excellent brush: good	good; agitation required	good; agitation required	spray: satisfactory brush: good	spray: excellent brush: good
Adhesion	4B	4B	4B	4B	4B
Dry Time: Set-to-touch Dry hard to recoat	17 min. 33 min. OK,2 hrs	5 min. 18 min. OK,2 hrs	24 min. 33 min. OK,2 hrs.	31 min. 6-3/4 hrs. OK,24 hrs.	33 min. 1-3/4 hrs. OK, 2hrs.
Appearance	spray: excellent brush: fair	good; uniform	good uniform	good: trace brush marks sprayed: slight orange peel	sprayed: excellent brush: fair
Abrasion Resistance (mg)	169	522	122	778	104
Flexibility, 1/4" mandrel	fail	fail	fail	fail	pass
Impact Resistance (inch pounds)	pass, 80	pass, 60	pass, 80	pass, 80	pass, 80
Accelerated Weathering: Reflectance Gloss	 - 7 units - 27 units	 no change no change	 - 2 units no change	 - 2 units no change	 - 1 unit - 34 units
Salt Spray***: scribed area unscribed area	10 10	7 5	10 0	10 5	10 7
Gloss, 60°	35	1.5	1.5	1.5	43
Heat Resistance	pass, 538°C	pass, 538°C	pass, 399°C	pass, 527°C	pass, 538°C
Water Immersion	no effect	discolored, no recovery	discolored	discolored, no recovery	no effect

a/b two component sample
* tests conducted by Subcontractor 1 on single component samples
** tests conducted by Subcontractor 2 on single component samples
*** exposure tests conducted by Subcontractor 3 on single component samples with evaluation by Contractor

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION HTI02

COATING CATEGORY: HIGH TEMPERATURE INDUSTRIAL MAINTENANCE COATINGS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	hard packed, mixed by mechanical methods to homogenous mixture
Total Non-volatile	ASTM D 2369	44.3% by wt.
Density	ASTM D 1475	1.075 g/ml
Viscosity	ASTM D 562	68 KU
Water	ASTM D 4017	0.05% by wt.
VOC	ASTM D 3960	599 g/L
Stability	ASTM D 1849	73 KU
Hardness	ASTM D 3363	Scratch >6H, Gouge >6H
Application Properties	FTMS 141c, 2131.1	spray: excellent brush: good
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 17 min. dry hard: 33 min. to recoat: OK, 2 hrs.
Appearance	FTMS 141C, 4541	spray: excellent brush: fair, brush marks
Abrasion Resistance	ASTM D 4060	169 mg.
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 7 unit decrease Gloss: 27 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 10
Gloss	ASTM D 523	35
Heat Resistance	ASTM D 2485	pass, 538°C (1000°F)
Water Immersion	ASTM D 870	no effect

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION HTI03a/HTI03b

COATING CATEGORY: HIGH TEMPERATURE INDUSTRIAL MAINTENANCE COATINGS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: OK, gray powder Component B: OK, liquid
Total Non-volatile	ASTM D 2369	85.7% by wt.
Density	ASTM D 1475	1.908 g/L
Viscosity	ASTM D 562	70 KU
Water	ASTM D 4017	<0.01% by wt.
VOC	ASTM D 3960	273 g/L
Stability	ASTM D 1849	70 KU
Hardness	ASTM D 3363	Scratch >6H, Gouge >6H
Application Properties	FTMS 141c, 2131.1	good, agitation required
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 5 min. dry hard: 18 min. to recoat: OK, 2 hrs.
Appearance	FTMS 141C, 4541	good, uniform
Abrasion Resistance	ASTM D 4060	522 mg.
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	pass, 60 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: no change Gloss: no change
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 7 unscribed area: 5
Gloss	ASTM D 523	1.5
Heat Resistance	ASTM D 2485	pass, 538°C (1000°F)
Water Immersion	ASTM D 870	discolored, no recovery

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION HTI04a/HTI04b

COATING CATEGORY: HIGH TEMPERATURE INDUSTRIAL MAINTENANCE COATINGS

TESTS	TEST METHOD	RESULT, AS APPLIED
Condition in Container	ASTM D 3925	Component A: OK, liquid Component B: OK, gray powder
Total Non-volatile	ASTM D 2369	78.8% by wt.
Density	ASTM D 1475	2.949 g/ml
Viscosity	ASTM D 562	82 KU
Water	ASTM D 3792	20.8% by wt.
VOC	ASTM D 3960	31 g/L
Stability	ASTM D 1849	82 KU
Hardness	ASTM D 3363	Scratch 5H, Gouge 3H
Application Properties	FTMS 141c, 2131.1	good, agitation required
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 24 min. dry hard: 33 min. to recoat: OK, 2 hrs.
Appearance	FTMS 141C, 4541	good, uniform
Abrasion Resistance	ASTM D 4060	122 mg.
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 2 unit increase Gloss: no change
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 0 white zinc reaction products
Gloss	ASTM D 523	1.5
Heat Resistance	ASTM D 2485	pass, 399°C (750°F)
Water Immersion	ASTM D 870	surface discolors, white zinc reaction products

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION HTI05

COATING CATEGORY: HIGH TEMPERATURE INDUSTRIAL MAINTENANCE COATINGS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily to homogenous state
Total Non-volatile	ASTM D 2369	90.3% by wt.
Density	ASTM D 1475	2.976 g/ml
Viscosity	ASTM D 562	102 KU
Water	ASTM D 3792	0.15% by wt.
VOC	ASTM D 3960	289 g/L
Stability	ASTM D 1849	104 KU
Hardness	ASTM D 3363	Scratch F, Gouge H
Application Properties	FTMS 141c, 2131.1	spray: satisfactory brush: good
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 31 min. dry hard: 6-3/4 hrs. to recoat: OK, 24 hrs.
Appearance	FTMS 141C, 4541	good, trace brush marks sprayed, slight orange peel
Abrasion Resistance	ASTM D 4060	778 mg.
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 2 unit increase Gloss: no change
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 5 (white zinc reaction products
Gloss	ASTM D 523	1.5
Heat Resistance	ASTM D 2485	pass, 527°C (800°F)
Water Immersion	ASTM D 870	discolored, no recovery

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION HTI06

COATING CATEGORY: HIGH TEMPERATURE INDUSTRIAL MAINTENANCE COATINGS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	hard packed, mixed by mechanical methods to homogenous state
Total Non-volatile	ASTM D 2369	44.8% by wt.
Density	ASTM D 1475	0.992 g/ml
Viscosity	ASTM D 562	55 KU
Water	ASTM D 4017	0.06% by wt.
VOC	ASTM D 3960	548 g/L
Stability	ASTM D 1849	54 KU
Hardness	ASTM D 3363	Scratch 5H, Gouge 5H
Application Properties	FTMS 141c, 2131.1	spray: excellent brush: good
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 33 min. dry hard: 1-3/4 hr. to recoat: OK, 2 hrs.
Appearance	FTMS 141C, 4541	sprayed: excellent brushed: fair, brush marks
Abrasion Resistance	ASTM D 4060	104 mg.
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Accelerated Weathering	ASTM G 53	Reflectance: 1 unit decrease Gloss: 34 unit decrease
Salt Spray	ASTM B 117 exposure ASTM D 1654 evaluation	scribed area: 10 unscribed area: 7
Gloss	ASTM D 523	43
Heat Resistance	ASTM D 2485	pass, 538°C (1000°F)
Water Immersion	ASTM D 870	no effect

TEST	CLEAR WOOD COATINGS or LACQUERS (page 1 of 2)														
	CWL01	CWL02	CWL03	CWL05	CWL06	CWL07	CWL09	CWL10	CWL11	CWL12	CWL13	CWL14	CWL SSE01	CWL SSE02	CWL SSE03
VOC (g/L)*	220	691	230	339	193	184	200	465	664	645	292	649	460	199	686
Total Non-volatile (% by wt)*	31.5	22.2	28.6	62.0	33.3	32.7	36.4	46.8	25.4	26.6	30.0	27.2	29.7	24.9	22.3
Density (g/ml)*	1.003	0.888	1.012	0.893	1.015	1.012	1.009	0.874	0.890	0.879	1.007	0.891	0.989	1.012	0.883
Viscosity (KU)**	62	55	54	56	82	63	58	57	55	58	56	58	57	55	57
Water Content (% by wt)	59.7*	0.17	63.2*	0.06	59.1*	60.2*	54.7*	0.06	0.62	0.37	57.9*	0.48	44.0*	69.2*	0.73
Stability*** (KU)	76	53	55	53	fail	61	63	54	53	53	55	56	fail	55	53
Freeze-Thaw Resistance (KU)	fail	N/A	54	N/A	86	110	fail	N/A	N/A	N/A	54	N/A	55	53	N/A
Blocking Resistance	10	0	9	5	10	9	8	8	10	10	3	0	N/A	N/A	N/A
Application Properties	good	good	fair	good	good	good	good	good	good	good	good	fair	good	good	good
Adhesion	0B	4B	5B	5B	0B	5B	5B	4B	5B	3B	5B	0B	0B	0B	3B
Dry Time: Set-to-touch	15 min.	7 min.	10 min.	1⅔hrs	5 min.	5 min.	5 min.	30 min.	3 min.	3 min.	10 min.	20 min.	10 min.	5 min.	2 min.
Dry hard	25 min.	15 min.	20 min.	5 hrs	30 min.	25 min.	1hr.	3¼ hr.	4 min.	12 min.	40 min.	25 min.	15 min.	20 min.	5 min.
to recoat	OK,1hr	OK,1 hr	OK,1 hr	OK,5hrs	OK1½hr	OK,1hr.	OK,1hr.	OK,4hr.	OK,1hr.	OK¾hr	OK,1hr.	OK,¾hr	OK35min	OK35min	OK30min
Appearance	good; uniform	good; uniform	fair	good; uniform	good	good	good; uniform	good; uniform	good; uniform	good; uniform	good; uniform	fair	good; uniform	good; uniform	good; uniform
Flexibility, 1/4" mandrel	pass	fail	pass	pass	pass	pass	pass	pass	pass	fail	pass	pass	pass	fail	fail

* tests conducted by Subcontractor 1 on single component samples
** tests conducted by Subcontractor 2 on single component samples
*** exposure tests conducted by Subcontractor 3 on single component samples with evaluation by Contractor

CLEAR WOOD COATINGS or LACQUERS
(page 2 of 2)

TEST	CWL01	CWL02	CWL03	CWL05	CWL06	CWL07	CWL09	CWL10	CWL11	CWL12	CWL13	CWL14	CWL SSE01	CWL SSE02	CWL SSE03
Impact Resistance (inch pounds)	pass,80	pass, 40	pass, 80	pass, 80	pass, 60	pass, 80	pass, 80	pass, 80	pass, 80	pass, 20	pass, 80	pass, 80	N/A	N/A	N/A
Gloss, 60° 24 hours	88	86	96	95	87	88	84	97	19	92	96	32			
7 days	88	86	94	94	87	88	82	97	19	92	95	28	N/A	N/A	N/A
Grain Raising of Wood	slight	no	slight	no	yes	slight	slight	no	no	no	no	no	slight	slight	no
Color of dried film	very slight amber	very slight amber	slight amber	amber	slight amber	slight amber	slight amber	light yellow	slight amber	slight amber	very faint amber	very slight amber	N/A	N/A	N/A
Yellowness difference (after UV)	-0.02 slight fading	-0.001 no change	+0.001 no change	+0.06 darkening/ yellowing	-0.001 no change	-0.03 bleaching/ lightening	-0.04 bleaching/ lightening	+0.01 darkening yellowing	+0.01 darkening yellowing	+0.09 definite yellowing	-0.02 fading/ lightening	+0.004 no change	N/A	N/A	N/A
Cold Check Resistance	pass,10 cycles	pass,10 cycles	pass,10 cycles	pass,10 cycles	pass,10 cycles	pass,10 cycles	pass,10 cycles	pass,10 cycles	pass,10 cycles	fail, 4 cycles	pass,10 cycles	pass,10 cycles	N/A	N/A	N/A
Print Resistance	c to b	b	no imprint	a	no imprint	c	b	c to b	no imprint	c	a	no imprint	N/A	N/A	N/A
Sanding Properties	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	fair	good	excellent
Chemical Resistance: Water	no effect	no effect	whitening, OK,18 hrs	slight haze OK,18 hrs	no effect	slight haze ring at 18 hrs whitening, 2&18 hrs	ring at 18 hrs	no effect	no effect	no effect	whitens, 2 hrs; ring, 18 hrs.	no effect	N/A	N/A	N/A
50% Alcohol	slight whitening	no effect	whitening, 2&18 hrs	no effect	slight whitening		whitens, defaced	no effect	no effect	no effect	whitens, 2 hrs;mars 18 hrs	soft,2hr; mars 18hrs			

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL01

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	31.5% by wt.
Density	ASTM D 1475	1.003 g/ml
Viscosity	ASTM D 562	62 KU
Water	ASTM D 3792	59.7% by wt.
VOC	ASTM D 3960	220 g/L
Stability	ASTM D 1849	76 KU
Freeze-Thaw Resistance	ASTM D 2243	fail
Blocking Resistance	ASTM D 4946	10
Application Properties	FTMS 141c, 2131.1 and 2141.1	good: easily applied by brush and spray
Adhesion	ASTM D 3359	0B
Dry Time	ASTM D 1640	set-to-touch: 15 min. dry hard: 25 min. to recoat: OK, 1 hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	Pass
Impact Resistance	ASTM D 2794	Pass, 80 inch pounds
Gloss	ASTM D 523	88 (24hrs), 88 (7 days)
Grain Raising of Wood	subjective	slight
Color of dried film, visual	subjective	very slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	-0.02 (slight fading)
Cold Check Resistance	ASTM D 1211	Pass, 10 cycles
Print Resistance	ASTM D 2091	"c" to "b"
Chemical Resistance	ASTM D 1308	
Water		no effect, 2 hrs. and 18 hrs.
50% alcohol		Slight whitening 2 and 18 hrs.

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL02

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily
Total Non-volatile	ASTM D 2369	22.2% by wt.
Density	ASTM D 1475	0.888 g/ml
Viscosity	ASTM D 562	55 KU
Water	ASTM D 4017	0.17% by wt.
VOC	ASTM D 3960	691 g/L
Stability	ASTM D 1849	53 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Blocking Resistance	ASTM D 4946	0
Application Properties	FTMS 141c, 2131.1	good: easily applied by spray
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 7 min. dry hard: 15 min. to recoat: OK, 1hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	fail
Impact Resistance	ASTM D 2794	pass, 40 inch pounds
Gloss	ASTM D 523	86 (24 hrs), 86 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	very slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	-0.001 (no change)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	"b"
Chemical Resistance	ASTM D 1308	
Water		No effect, 2 or 18 hrs.
50% alcohol		No effect, 2 or 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 03-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL03

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	28.6% by wt.
Density	ASTM D 1475	1.012 g/ml
Viscosity	ASTM D 562	54 KU
Water	ASTM D 3792	63.2% by wt.
VOC	ASTM D 3960	230 g/L
Stability	ASTM D 1849	55 KU
Freeze-Thaw Resistance	ASTM D 2243	54 KU
Blocking Resistance	ASTM D 4946	9
Application Properties	FTMS 141c, 2131.1 and 2141.1	fair: bubbles when applied by brush or spray
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 10 min. dry hard: 20 min. to recoat: OK, 1 hr.
Appearance	FTMS 141C, 4541	fair
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	96 (24 hrs.), 94 (7 days)
Grain Raising of Wood	subjective	slight
Color of dried film, visual	subjective	slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	+0.001 (no change)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	No Imprint
Chemical Resistance	ASTM D 1308	
Water		whitening 2 hrs., OK 18 hrs.
50% alcohol		whitening 2 hrs. and 18 hrs

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL05

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	62.0% by wt.
Density	ASTM D 1475	0.893 g/ml
Viscosity	ASTM D 562	56 KU
Water	ASTM D 4017	0.06% by wt.
VOC	ASTM D 3960	339 g/L
Stability	ASTM D 1849	53 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Blocking Resistance	ASTM D 4946	5
Application Properties	FTMS 141c, 2131.1 and 2141.1	good: easily applied by brush and spray
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 1-2/3 hrs. dry hard: 5 hrs. to recoat: OK, 5 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	95 (24 hrs.) 94 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	+0.06 (darkening & yellowing)
Cold Check Resistance	ASTM D 1211	Pass, 10 cycles
Print Resistance	ASTM D 2091	"a"
Chemical Resistance	ASTM D 1308	
Water		slight haze 2 hrs., OK 18 hrs.
50% alcohol		no effect, 2 and 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

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SAMPLE IDENTIFICATION CWL06

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	33.3% by wt.
Density	ASTM D 1475	1.015 g/ml
Viscosity	ASTM D 562	82 KU
Water	ASTM D 3792	59.1% by wt.
VOC	ASTM D 3960	193 g/L
Stability	ASTM D 1849	fail
Freeze-Thaw Resistance	ASTM D 2243	86 KU
Blocking Resistance	ASTM D 4946	10
Application Properties	FTMS 141c, 2131.1	good: easily applied by spray
Adhesion	ASTM D 3359	0B
Dry Time	ASTM D 1640	set-to-touch: 5 min. dry hard: 30 min. to recoat: OK, 1-1/2 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 60 in. lb.
Gloss	ASTM D 523	87 (24 hrs.) 87 (7 days)
Grain Raising of Wood	subjective	Yes
Color of dried film, visual	subjective	slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	-0.001 (no change)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	No Imprint
Chemical Resistance	ASTM D 1308	
Water		no effect, 2 and 18 hrs.
50% alcohol		slight whitening, 2 and 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 03-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL07

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily
Total Non-volatile	ASTM D 2369	32.7% by wt.
Density	ASTM D 1475	1.012 g/ml
Viscosity	ASTM D 562	63 KU
Water	ASTM D 3792	60.2% by wt.
VOC	ASTM D 3960	184 g/L
Stability	ASTM D 1849	61 KU
Freeze-Thaw Resistance	ASTM D 2243	110 KU
Blocking Resistance	ASTM D 4946	9
Application Properties	FTMS 141c, 2131.1 and 2141.1	good: easily applied by brush and spray
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 5 min. dry hard: 25 min. to recoat: OK, 1 hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	88 (24 hrs.) 88 (7 days)
Grain Raising of Wood	subjective	slight
Color of dried film, visual	subjective	slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	-0.03 (bleaching,lightening)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	"c"
Chemical Resistance	ASTM D 1308	
Water		slight haze 2hrs., ring 18 hours
50% alcohol		whitening, 2 and 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 08-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL09

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft packed, mixes readily
Total Non-volatile	ASTM D 2369	36.4% by wt.
Density	ASTM D 1475	1.009 g/ml
Viscosity	ASTM D 562	58 KU
Water	ASTM D 3792	54.7% by wt.
VOC	ASTM D 3960	200 g/L
Stability	ASTM D 1849	63 KU
Freeze-Thaw Resistance	ASTM D 2243	fail
Blocking Resistance	ASTM D 4946	8
Application Properties	FTMS 141c, 2131.1 and 2141.1	good: easily applied brush and spray
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 5 min. dry hard: 1 hr. to recoat: OK, 1hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	84 (24 hrs.) 82 (7 days)
Grain Raising of Wood	subjective	slight
Color of dried film, visual	subjective	slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	-0.04 (bleaching, lightening)
Cold Check Resistance	ASTM D 1211	Pass, 10 cycles
Print Resistance	ASTM D 2091	"b"
Chemical Resistance	ASTM D 1308	
Water		OK 2 hrs., ring 18 hrs.
50% alcohol		whitens 2 hrs., defaced 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL10

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	46.8% by wt.
Density	ASTM D 1475	0.874 g/ml
Viscosity	ASTM D 562	57 KU
Water	ASTM D 4017	0.06% by wt.
VOC	ASTM D 3960	465 g/L
Stability	ASTM D 1849	54 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Blocking Resistance	ASTM D 4946	8
Application Properties	FTMS 141c, 2131.1 and 2141.1	good: easily applied by brush and spray
Adhesion	ASTM D 3359	4B
Dry Time	ASTM D 1640	set-to-touch: 30 min. dry hard: 3-1/4 hrs. to recoat: OK, 4 hrs.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	97 (24 hours) 97 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	light yellow
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	+0.01 (darkening, yellowing)
Cold Check Resistance	ASTM D 1211	Pass, 10 cycles
Print Resistance	ASTM D 2091	"c" to "b"
Chemical Resistance	ASTM D 1308	
Water		No effect, 2 or 18 hrs.
50% alcohol		No effect, 2 or 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL11

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	25.4% by wt.
Density	ASTM D 1475	0.890 g/ml
Viscosity	ASTM D 562	55 KU
Water	ASTM D 4017	0.62% by wt.
VOC	ASTM D 3960	664 g/L
Stability	ASTM D 1849	53 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Blocking Resistance	ASTM D 4946	10
Application Properties	FTMS 141c, 2131.1	good: easily applied by spray
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 3 min. dry hard: 4 min. to recoat: OK, 1hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	19 (24 hrs.) 19 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	+0.01 (darkening, yellowing)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	No imprint
Chemical Resistance	ASTM D 1308	
Water		no effect, 2 or 18 hrs.
50% alcohol		no effect, 2 or 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 03-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL12

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	26.6% by wt.
Density	ASTM D 1475	0.879 g/ml
Viscosity	ASTM D 562	58 KU
Water	ASTM D 4017	0.37% by wt.
VOC	ASTM D 3960	645 g/L
Stability	ASTM D 1849	53 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Blocking Resistance	ASTM D 4946	10
Application Properties	FTMS 141c, 2131.1	good: easily applied by spray
Adhesion	ASTM D 3359	3B
Dry Time	ASTM D 1640	set-to-touch: 3 min. dry hard: 12 min. to recoat: OK, 3/4 hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	fails
Impact Resistance	ASTM D 2794	pass, 20 in. lb.
Gloss	ASTM D 523	92 (24 hrs.) 92 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	+0.09 (definite yellowing)
Cold Check Resistance	ASTM D 1211	fail, 4 cycles
Print Resistance	ASTM D 2091	"c"
Chemical Resistance	ASTM D 1308	
Water		no effect, 2 or 18 hrs.
50% alcohol		no effect, 2 or 18 hrs.

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL13

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	30.0% by wt.
Density	ASTM D 1475	1.007 g/ml
Viscosity	ASTM D 562	56 KU
Water	ASTM D 3792	57.9% by wt.
VOC	ASTM D 3960	292 g/L
Stability	ASTM D 1849	55 KU
Freeze-Thaw Resistance	ASTM D 2243	54 KU
Blocking Resistance	ASTM D 4946	3
Application Properties	FTMS 141c, 2131.1 and 2141.1	good: easily applied by brush and spray
Adhesion	ASTM D 3359	5B
Dry Time	ASTM D 1640	set-to-touch: 10 min. dry hard: 40 min. to recoat: OK, 1hr.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	96 (24 hrs.) 95 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	very faint amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G 23	-0.02 (fading, lightening)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	"a"
Chemical Resistance	ASTM D 1308	
Water		whitens 2hrs., ring 18 hrs.
50% alcohol		whitens 2 hrs., marred 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 05-27-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL14

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	soft pack, mixes readily
Total Non-volatile	ASTM D 2369	27.2% by wt.
Density	ASTM D 1475	0.891 g/ml
Viscosity	ASTM D 562	58 KU
Water	ASTM D 4017	0.48% by wt.
VOC	ASTM D 3960	649 g/L
Stability	ASTM D 1849	56 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Blocking Resistance	ASTM D 4946	0
Application Properties	FTMS 141c, 2131.1	fair
Adhesion	ASTM D 3359	0B
Dry Time	ASTM D 1640	set-to-touch: 20 min. dry hard: 25 min. to recoat: OK, 45 min.
Appearance	FTMS 141C, 4541	fair
Flexibility	ASTM D 522	pass
Impact Resistance	ASTM D 2794	pass, 80 in. lb.
Gloss	ASTM D 523	32 (24 hrs.) 28 (7 days)
Grain Raising of Wood	subjective	No
Color of dried film, visual	subjective	very slight amber
Yellowness difference after ultraviolet light exposure	FTMS 141C, 6131 and ASTM G23	+0.004 (no change)
Cold Check Resistance	ASTM D 1211	pass, 10 cycles
Print Resistance	ASTM D 2091	No imprint
Chemical Resistance	ASTM D 1308	
Water		no effect, 2 or 18 hrs.
50% alcohol		film soft 2 hrs., marred 18 hrs.

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL/SSE01

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogenous
Total Non-volatile	ASTM D 2369	29.7% by wt.
Density	ASTM D 1475	0.989 g/ml
Viscosity	ASTM D 562	57 KU
Water	ASTM D 3792	44.0% by wt.
VOC	ASTM D 3960	460 g/L
Stability	ASTM D 1849	fail
Freeze-Thaw Resistance	ASTM D 2243	55 KU
Application Properties	FTMS 141c, 2131.1	good: easily applied by spray
Adhesion	ASTM D 3359	0B
Dry Time	ASTM D 1640	set-to-touch: 10 min. dry hard: 15 min. to recoat: OK, 35 min.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	pass
Grain Raising of Wood	subjective	slight
Sanding Properties	FTMS 141C, 6321	fair: gums paper, not uniform

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 03-30-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL/SSE02

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogeneous
Total Non-volatile	ASTM D 2369	24.9% by wt.
Density	ASTM D 1475	1.012 g/ml
Viscosity	ASTM D 562	55 KU
Water	ASTM D 3792	69.2% by wt.
VOC	ASTM D 3960	199 g/L
Stability	ASTM D 1849	55 KU
Freeze-Thaw Resistance	ASTM D 2243	53 KU
Application Properties	FTMS 141c, 2131.1,	good: easily applied by spray
Adhesion	ASTM D 3359	0B
Dry Time	ASTM D 1640	set-to-touch: 5 min. dry hard: 20 min. to recoat: OK, 35 min.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	fails
Grain Raising of Wood	subjective	slight
Sanding Properties	FTMS 141C, 6321	good: slight gumming of paper

LABORATORY TEST RESULTS

CLIENT: CALIFORNIA AIR RESOURCES BOARD DATE RECD: 02-24-94 OUR FILE: P-9206

CONTRACT NO. 92-339

SAMPLE IDENTIFICATION CWL/SSE03

COATING CATEGORY: CLEAR WOOD COATINGS or LACQUERS

TESTS	TEST METHOD	RESULT
Condition in Container	ASTM D 3925	homogeneous
Total Non-volatile	ASTM D 2369	22.3% by wt.
Density	ASTM D 1475	0.883 g/ml
Viscosity	ASTM D 562	57 KU
Water	ASTM D 4017	0.73% by wt.
VOC	ASTM D 3960	686 g/L
Stability	ASTM D 1849	53 KU
Freeze-Thaw Resistance	ASTM D 2243	not applicable
Application Properties	FTMS 141c, 2131.1	good: easily applied by spray
Adhesion	ASTM D 3359	3B
Dry Time	ASTM D 1640	set-to-touch: 2 min. dry hard: 5 min. to recoat: OK, 30 min.
Appearance	FTMS 141C, 4541	good: uniform
Flexibility	ASTM D 522	fail
Grain Raising of Wood	subjective	No
Sanding Properties	FTMS 141C, 6321	Excellent: powders, no gumming of paper, sands smooth and uniform